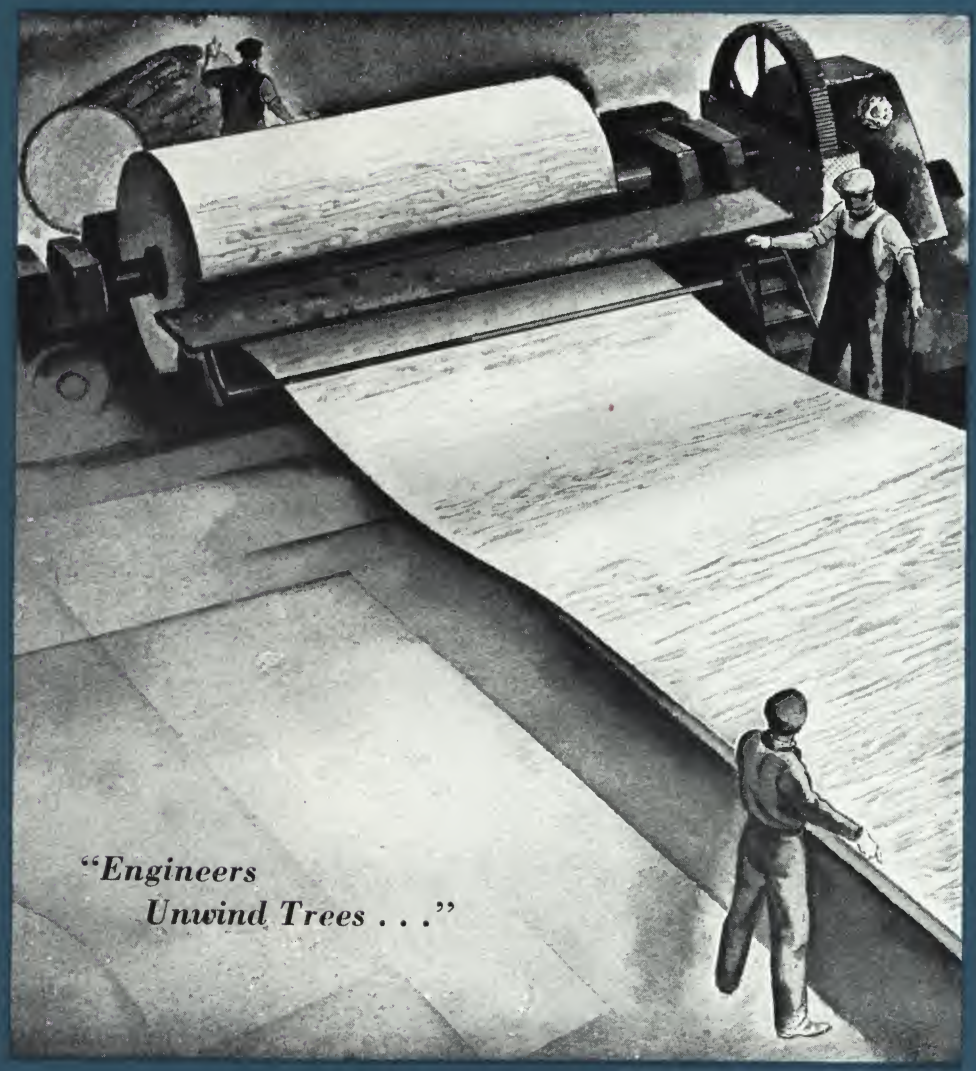
Facts about DOUGLAS FIR PLYWOOD



"Engineers Unwind Trees . . ."

DOUGLAS FIR PLYWOOD ASSOCIATION

RESEARCH AND ADVERTISING HEADQUARTERS

SIXTH FLOOR, SKINNER BUILDING, SEATTLE, WASHINGTON

DOUGLAS FIR PLYWOOD ASSOCIATION

RESEARCH AND ADVERTISING HEADQUARTERS
Sixth Floor, Skinner Building, Seattle Washington

The Association

A non-profit organization of all United States manufacturers of Douglas Fir Plywood, founded to sponsor a continuing program of technical research, to promote the use of this material in construction and industry, and to help users employ it to the best advantage.

Inquiries as to the characteristics or uses of Douglas Fir Plywood will receive the prompt attention of our Research Director. Address DOUGLAS FIR PLYWOOD ASSOCIATION, Research and Advertising Headquarters, Dept. 136-Z, Skinner Building, Seattle, Washington, or any of the following member mills:

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● THE PRODUCT

Douglas Fir Plywood consists of an odd number of thin sheets, or veneers, of selected old-growth Douglas Fir—3, 5, or 7 in standard thicknesses—these being laminated with alternating grain direction. The major processes of manufacture are illustrated on this page.

The water-resistant glue used, after setting under hydraulic pressure, forms a bond of high shear strength, far stronger, in fact, than the wood fibers themselves.

In the manufacture of Douglas Fir Plywood, only the choicest Douglas Fir logs are used. These are the so-called "peeler" logs, which are less than 10% of the total production of Douglas Fir logs. Douglas Fir grows on the Pacific slope, where climatic conditions produce a wood combining soft texture and light weight with extraordinary strength. Because of these characteristics, Douglas Fir is widely specified for heavy structural timbers.

● PHYSICAL CHARACTERISTICS

(Test Data on Pages 7, 8 and 11)

Because the veneers are rotary-cut, not sawn, Douglas Fir Plywood is available in standard sizes as large as 4 x 8 feet—and in even larger sizes on special order. Largely because of these sizes, Douglas Fir Plywood makes possible savings of 40% to 75% over ordinary lumber in handling and labor costs.

Because the grain of each ply composing the material is at right angles to the grain of adjacent plies, the strength of a Douglas Fir Plywood panel is approximately equal in both directions. By contrast, the tensile strength of ordinary lumber may be twenty times as high parallel to the grain as across it, and the modulus of elasticity from fifteen to twenty times as high. Therefore, a panel of Douglas Fir Plywood will do the work of solid lumber very much thicker and heavier.

Because of its nearly equalized shear strength, Douglas Fir Plywood has no plane of cleavage. Hence it cannot be split except by extraordinary force. For example, it is practically impossible to split even a small piece with a hatchet or axe. Nails and screws can be driven almost at the very edges.

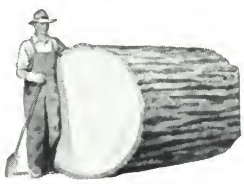
As each veneer, or ply, is scientifically dried before the gluing process, and as any tendency of an individual ply to shrink or expand is prevented by the opposing grain of adjacent plies, Douglas Fir Plywood is extraordinarily warp-resistant. Once in place, it is *warp-proof*.

Its light weight is demonstrated by the fact that a cubic foot of ⅜-in. 3-ply of 10% moisture content—for example—weighs only 34 lbs.

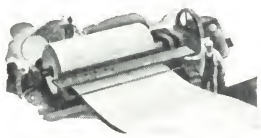
Douglas Fir Plywood comes sanded to satin-smoothness, reducing labor costs at the point of construction.

To summarize, Douglas Fir Plywood combines the good qualities of lumber with the convenience of wallboard size, yet is far stronger than *either* lumber or composition wallboard.

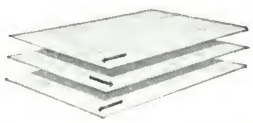
How Douglas Fir Plywood is made:



1 Selected Douglas Fir logs are cut to length and barked.



2 Then turned on a giant lathe and peeled off into endless lengths of thin wood sheets.



3 These sheets of wood are cut to size, laid cross-grain, and glued together flat with water-resistant glue under hydraulic pressure. (Arrows show direction of grain.)

4 The result is a new and better lumber having all the good qualities of natural wood plus the size and convenience of wallboard—but with advantages of strength, stiffness, and freedom-from-splitting which neither lumber nor wallboard has.

● AVAILABLE THROUGHOUT THE U. S.

Most progressive building material dealers in every section of the country stock Douglas Fir Plywood in an assortment of sizes and grades. However, if you are unable to obtain it in your community, write Douglas Fir Plywood Association, Research and Advertising Headquarters, Dept. 136-Z, Skinner Bldg., Seattle, Wash.

● PRICE

Douglas Fir Plywood is the least expensive of all water-resistant plywoods. In most thicknesses, it costs less per surface foot than equivalent ordinary lumber. It costs no more than composition boards. For example, the new ¼-in. Douglas Fir Plywood Wallboard retails for around 4 to 7c a sq. ft., depending on quantity and the dealer's freight cost.

Left: With Douglas Fir Plywood, the batten treatment of joints makes possible attractive and inexpensive walls and ceilings

Below: Stained and waxed, the natural wood grain of Douglas Fir Plywood Wallboard panels, adds distinctive charm to this living room

Below: Presumably an expensive plaster job, the walls and ceilings of this beautiful Colonial living room are actually made of damage-proof Douglas Fir Plywood, painted and stippled

● REPRESENTATIVE USES

Space permits mention of only a few of the hundreds of uses for which Douglas Fir Plywood's unique characteristics have won it acceptance.

Crack-proof Walls and Ceilings
Garages and Lining
Wainscoting
Concrete Forms
Subflooring
Dust-proof Drawers and Drawer Bottoms
Booth Paneling
Bulletin Boards
Breakfast Nooks
Dust-proof Coal Bins
Store Fixtures
Clothes Chutes
Portable Houses
Cupboards
Automobile Body Parts
Freight Car Lining
Boxes and Crates
Radio Cabinets
Modern Furniture
Kitchen Cabinets
Window Seats
Ironing Boards
Window Valances
Wardrobes
Office and Other Partitions
Shelving
Closets
Bins
Bookcases
Screens
Cabinets
Sheathing
Lockers
Porch Sun Rooms
Squeakless Flooring
Table-tennis Tables
Desks
Tables
Window Displays
Bread Boards
Chests
Benches
Medicine Cabinets

● CRACK-PROOF WALLS AND CEILINGS

Used for walls and ceilings, Douglas Fir Plywood gives crack-proof strength and a smoothly sanded natural-wood surface that takes *any* finish—natural-grain, paint, plastics or paper. Being both low in surface-foot cost and repair-free, this versatile material is more economical in the long run than lath-and-plaster, solid-wood paneling, or any composition wallboard.

As an insulating material Douglas Fir Plywood is at least 20% superior to ordinary lumber. The big panels reduce to a minimum the lineal footage of joints—and these joints *stay tight*—permanently proof against air infiltration, thus providing also the valuable insulation of dead air space.

The new ¼-in. Douglas Fir Plywood Wallboard is the most widely used grade and thickness for walls and ceilings. For especially substantial construction, ½-in. or even thicker is sometimes used.

As Douglas Fir Plywood is *real* lumber, not a composition material, it cannot budge, sag or crumble. Leaking roofs or plumbing will not discolor Douglas Fir Plywood walls except under extreme conditions.

Below: Note the unusual effect obtained in the ceiling of this modern room by using a stenciled design on panels of Douglas Fir Plywood. The walls and built-ins are also of Plywood

● WAINSCOTING

Both because Douglas Fir Plywood combines low surface-foot cost with labor-saving sizes, and because it lends itself to so many attractive finishes, this material is increasingly preferred for wainscoting.

Right: Because it stands the hardest kind of wear and tear without cracking or splitting, Douglas Fir Plywood is the ideal material for recreation room walls and ceilings

Below: This new ¼-in. Douglas Fir Plywood Wallboard can be bent without steaming to form the pleasing curves of a stair well

● PARTITIONS

Douglas Fir Plywood's great strength and giant panel sizes make it an ideal material for partitions. It is labor-saving and damage-proof. Unlike partitions of composition board or plaster, the strength of which is primarily in the framework, Douglas Fir Plywood partitions are homogeneous structures extraordinarily resistant to all stresses.

A plywood partition—if not less than ½-in. thick—requires no studding, simply a cap and shoe.

Douglas Fir Plywood is an ideal material for removable partitions, because of the large units. Also, Douglas Fir Plywood partitions can be dismantled easily for the same reason, and the remarkable strength of the Plywood minimizes damage to it when this is done.

● SUBFLOORING AND FLOORING

For subflooring, or for flooring to be covered by carpet or linoleum, Douglas Fir Plywood offers a combination of economies and other advantages not otherwise obtainable.

The huge panels save at least 60% in flooring and subflooring labor, by minimizing the work of sawing, fitting, joining and nailing. The great reduction in lineal footage of joints, and the fact that plywood joints will not open, practically eliminates air leakage. And, in addition, Douglas Fir Plywood is approximately 20% more effective as an insulator than ordinary lumber.

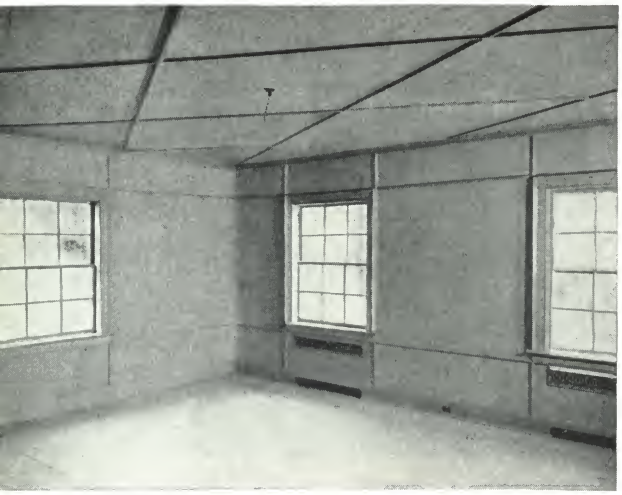
Used as subflooring, Douglas Fir Plywood contributes much greater structural strength than ordinary materials. The ¾-in. thickness is most often used for subflooring.

Finally, Douglas Fir Plywood floors and subfloors tend to *prevent squeaking,* because this material grips nails more tenaciously than ordinary lumber and because the thicker panels do not yield under the weight of a person walking.

Not being lapped at the edge, every square inch of Douglas Fir Plywood covers surface. This means a 20% saving over shiplap subflooring in material footage alone.

Douglas Fir Plywood is also used, as in an auditorium or convention hall, to protect permanent flooring while the building is being used for sporting events or similar gatherings. The large lightweight sections can be laid down or taken up quickly.

Below: Below are the unfinished walls and ceiling of a bedroom which will never crack nor crumble. And this attractive method of batten treatment at joints is surprisingly inexpensive



Below: For decorative treatment Douglas Fir Plywood suggests limitless possibilities as it takes any stain, paint or plastic finish. This photograph illustrates the bedroom shown above, after finishing

● SHEATHING

For virtually the same reasons that recommend it for subflooring—labor-saving, insulation, and greatly increased structural strength—Douglas Fir Plywood is far superior to shiplap for sheathing. The saving in labor amounts to approximately 60%.

As the extraordinary strength of this material is approximately equal in both directions, Douglas Fir Plywood sheathing provides far greater rigidity than expensive diagonal bracing—yet without extra labor or materials.

Douglas Fir Plywood sheathing is damage-proof and will withstand terrific strain. We quote from a report covering dynamic and static tests made at Stanford University and conducted by Lydik S. Jacobsen, Associate Professor of Research. In these tests four types of materials were used: two of the best known composition boards, Douglas Fir Plywood and one of solid lumber. ¼-in. plywood was used in these tests because thicker stock in the other products used for comparison was not available. ⅝-in. or ¾-in. plywood is recommended for sheathing, and, had these thicknesses been used throughout, comparisons would have shown an even more favorable result for plywood.

"For purposes of sheathing closed panels (sections) to resist seismic loads with a minimum distortion of nailed joints, the ¼-in. plywood is decidedly superior to any of the other forms of sheathing.

"In the static tests following the dynamic, panels (sections) sheathed with ¼-in. plywood are decidedly superior to panels sheathed with any of

the other forms of sheathing in regard to minimum elastic distortion, maximum load, maximum stiffness recovery, and maximum resilience for a given distortion of 1.5 inches.

"Closed panels (sections) with the three forms of ¼-in. sheathing give much greater dynamic and static rigidity than the ordinary $\frac{7}{16}$ x 3 Pine diagonal sheathing.

"Only in the case of the panels with ¼-in. plywood sheathing did the sheathing itself suffer no damage. If the frames had been made of stronger material than clear pine, the plywood panels would have shown greater stiffness and strength both dynamically and statically. The nail holding power of the frame studding seems to be the limiting factor of these panels.

"The light weight of the ¼-in. plywood panels constitutes an additional factor of safety if the structure is subjected to dynamic loads of seismic origin."

● USED AS A CABINET LUMBER

Warp-proof Doors—Douglas Fir Plywood has long been widely used for door panels and for constructing dustproof flush doors. In both it combines lightweight strength with extraordinary warp-resistance, at modest cost. The construction of flush doors becomes a simple carpentry job with this material.

Closets, Cupboards and Cabinets—By eliminating piecing and fitting, Douglas Fir Plywood's large panel sizes greatly reduce the cost of this kind of construction, besides giving it split-proof, warp-resistant strength. Cabinet drawers, bins and doors made of Douglas Fir Plywood will never stick, and the joints remain permanently tight and dust-proof. Nails and screws can be placed close to the edges without danger of splitting.

Shelving and Bookcases—Warp-proof, split-proof shelving and bookcases can be built with Douglas Fir Plywood for even less than if ordinary lumber were used. Moreover, plywood shelving can be thinner—more graceful in appearance—without sacrifice of strength.

Breakfast Nooks and Other Built-ins—Damage-proof built-ins, breakfast nooks, ironing boards, window seats, etc., can now be built at considerably lower cost, with Douglas Fir Plywood. This is because it eliminates piecing and glue-up work, and because of the low surface-foot cost of the material.

Store Fixtures—Douglas Fir Plywood builds extra-strength, repair-free store fixtures at a lower cost than any other suitable cabinet lumber. Moreover, doors, drawers and bins of Douglas Fir Plywood keep merchandise dust-proof.

● FINISHING DOUGLAS FIR PLYWOOD

For Interior Use—

Priming—White and light-colored enamel finishes are best primed with equal parts of white lead, turpentine, and *boiled* oil or interior varnish. A primer especially effective to prevent checking of enamel may be prepared quickly from one part commercial shellac and six to eight parts of denatured alcohol. *Do not use gloss oil—it may yellow the finished surface.*

Priming coats should be applied either before the plywood is in place, or as soon afterward as possible, to prevent "raising" of the grain. However, a Swedish or hard-putty glaze over the primer will immediately level the surface again.

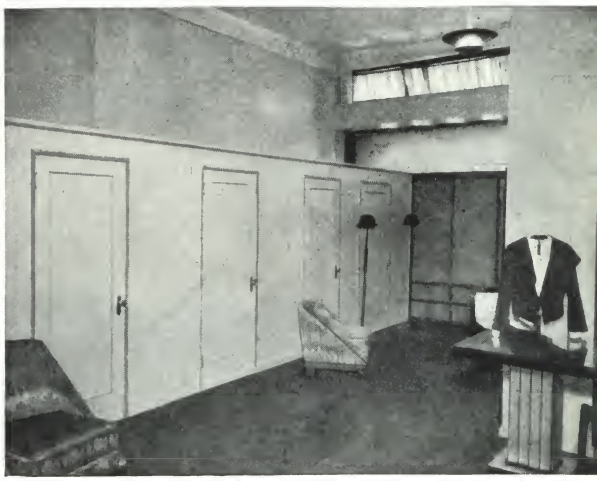
Room temperature for either varnish or enamel work should not fall much below 70 degrees.

Enamel Finishes—After priming, use two coats of any high-grade undercoater. For a fine four-coat surface, do not thin the final coat unless otherwise specified by the paint manufacturer. Use only tinting colors ground in oil, and tint the undercoats as well as the final enamel coat. The priming, second and third coats should be sandpapered, but on the last coat under the enamel only No. 00 sandpaper should be used. If an especially fine finish is desired, apply one or more extra coats, rubbing between coats with pumice and water. Rub the final coat with pumice and oil.

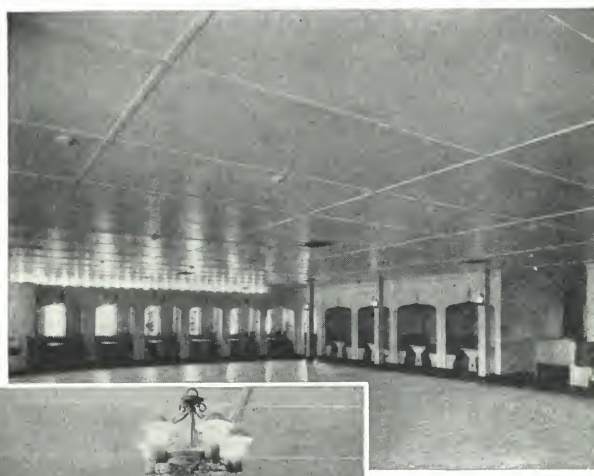
Painting and Staining—For ordinary purposes, finish Douglas Fir Plywood like any other wood. Beautiful soft stained effects ranging from blue grey to brown grey may be obtained with nigrosine and chloride of iron, the color intensity being regulated by the amount of water used in mixing. Further variations may be created by adding other acids. Finish with shellac and wax, varnish and wax, or other usual top finishes.

Above: Low surface-foot cost and resistance to warping and splitting make Douglas Fir Plywood the ideal material for restaurant and store fixtures

Below: Besides saving floor space this material saves construction time and costs much less than lath and plaster and may be finished to give exactly the same appearance



Below: For large areas, in public gathering places, where expense and durability are to be considered, Douglas Fir Plywood is invaluable. Besides their damage-proof strength, these giant plywood panels greatly reduce labor costs. The ¼-in. Douglas Fir Plywood Wallboard is easily curved without steaming to form the curved surfaces so often necessary in bars and fountains



Plastic Finishes—Prime as suggested for enamel finishes. Plastic finishes with either a water or oil-and-varnish base may be used. If haste is necessary, white shellac may be used as a substitute for the lead, oil and turpentine priming.

Glazed or Stippled Effects—Coat as suggested for enamel finishes, add the usual undercoats, then glaze or stipple. Staining colors ground in linseed oil may be used. Any of the usual solvents are satisfactory, with some oil or varnish for additional binder. Subsequent coats may be shellac and wax. The final coat should be rubbed with pumice and oil.

Sand-etched and Steel-brushed Effects—The distinctive grain of Douglas Fir Plywood lends itself perfectly to these beautiful new effects, in which a portion of the softer springwood is removed by sand-etching or by brushing parallel with the grain with flexible wire bristles.

For dark effects, use water stains or staining pigments ground in oil. Let the latter dry without wiping. After the stain has dried, apply a lighter-colored paste filler, let it set a short time, then wipe off.

This filler should be slightly darker than the stain-

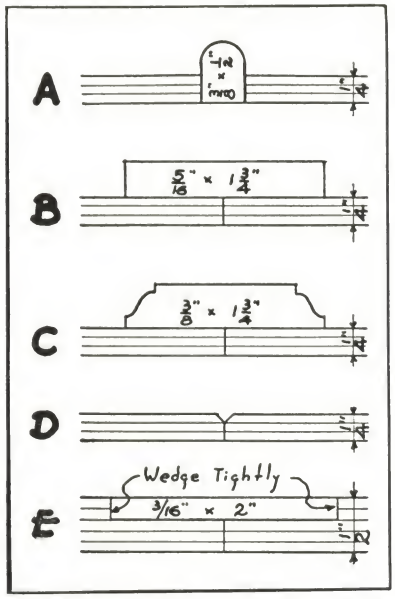
Five Typical Treatments of Joints

Although the usual practice is to cover the joints with battens—either of the plain flat type (B) or with battens having moulded edges, as in (C)—Douglas Fir Plywood's resistance to shrinking and swelling permits other joint treatments.

In (A) is shown the European vogue, in which a small bead, plain or decorative, is set between the panels.

The attractive V-joint shown in (D) also is used extensively. This joint is made by chamfering the edges of the panels slightly with a plane—after each panel is fitted but before it is fastened to the wall.

The joint treatment shown in (E) provides an absolutely flush wall, and for this purpose we recommend Douglas Fir Plywood not less than ½-in. thick. The edges of the panel or sections are rabbeted, and a thin strip one or two inches wide is wedged tightly and glued into place.



Right: When economical construction is important Douglas Fir Plywood will assure satisfaction. It costs less per surface-foot than ordinary lumber and saves 40 to 75% labor

Below: This photograph admirably illustrates Douglas Fir Plywood's remarkable versatility. The walls and ceilings, bins, cupboards, and cupboard doors, sink wings, built-in china and linen closet, and table top are all of this split-proof, warp-resistant lumber

Below: Exposed joints and a natural wood finish of these Douglas Fir Plywood walls combine to make a smart modern effect

Standard Sizes

Standard Widths—Beginning at 12 in., increasing by 2 in. units to 30 in., also 36, 42 and 48 in., or larger on special order. Wallboard widths, 32 and 48 in.

Standard Lengths—48, 60, 72, 84, 96 in., or larger on special order.

Standard Thicknesses—Beginning at $\frac{3}{16}$ in. 3-ply, increasing by $\frac{1}{16}$ in. units to $1\frac{3}{16}$ in. 7-ply, or thicker on special order. Wallboard thicknesses—$\frac{3}{16}$ in. unsanded and ¼ in. sanded 2 sides.

Note: On special order, Douglas Fir Plywood can be manufactured to your exact specifications—in special thicknesses, in special combinations of plies, in special shapes, drilled or specially treated.

Douglas Fir Plywood Grades

Good Two Sides (G-2-S)—This grade is intended for natural or light stain finishes. Both faces are clear and 100% heartwood of a yellow or pinkish color.

Good One Side (G-1-S)—One face is the same as that described under Good Two Sides grade, while the opposite face is the same as the Sound Two Sides grade described below.

Sound Two Sides (SO-2-S)—This grade presents a smooth, sound surface on both sides suitable for painting. The faces may be of one or more pieces of firm, smoothly cut veneer. If of more than one piece, they will be well-joined, edge-glued and reasonably matched for grain and color at the joints. Sap and natural discoloration are considered no defect.

Wallboard (W-B)—The face side is the same as described under the Sound Two Sides. The opposite side contains defects in number and size that will not affect the strength or serviceability of the panel.

Concrete Form Material—While various thicknesses are made on special order, two thicknesses are standard—⅝-in. and ¼-in. (after sanding). The ¼-in. thickness is recommended for curved forms and form lining. Panel faces are free from knots, open defects and sap, and are made with the most highly water resistant glue available. At additional cost panels will be treated at the mill with a satisfactory form oil (or other preparation).

Sheathing—Both faces of this 3-ply $\frac{5}{16}$ in. and $\frac{3}{16}$ in. unsanded plywood contain defects which will not seriously affect strength or serviceability.

ing or base color. Dark, bold effects, or the softest pastel effects can be achieved by varying the colors and treatments suggested above.

For Exterior Uses—

Edges and outside surfaces of plywood exposed to weather should be finished carefully with three coats of high-quality paint. In extremely damp localities, the interior should be coated also.

Priming — Without exception, ready-mixed paints used for priming should be reduced with pure raw linseed oil—usually with one gallon of oil to one of paint. Apply subsequent coats as the paint manufacturer recommends.

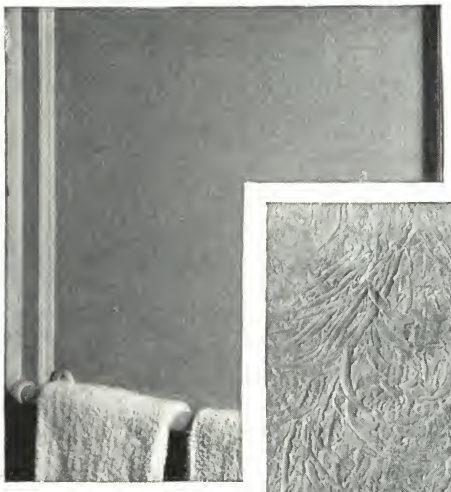
In mixing aluminum paint, which is especially moisture-resistant, use only high-grade vehicles—such as kettle-bodied boiled oil or long oil spar varnish. Do not use ordinary boiled oil or raw linseed oil. Many paint manufacturers now offer a vehicle specifically prepared for aluminum powder.

Methods of Application—On large unbroken surfaces, apply priming and subsequent coats like calcimine—sweeping the brush in semi-circular fashion. If the surface is small or broken by paneling, etc., follow the grain.

Use no turpentine or other thinner in the last coat. Use driers very sparingly, as they shorten the life of the paint. Ample time should be allowed between the priming and other coatings.

Stained Exteriors—Most oil stains on the market will give good results, but avoid those containing too much thinner. Job-mixed stains may be prepared with standard staining pigments and linseed oil or spar varnish.

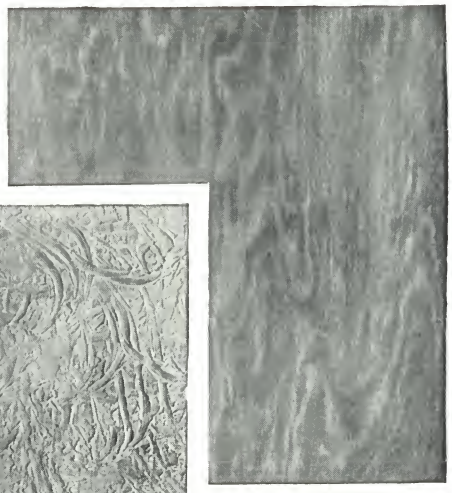
After the stain is dry, apply one or more coats of high-grade spar varnish. Never use shellac on Douglas Fir Plywood exposed to weather.



Paint Finish

Douglas Fir Plywood walls and ceilings may present either a paneled or a continuous surface. This real-lumber wallboard lends itself to a multiplicity of decorative treatments

Plastic Finish



Stain Finish

Douglas Fir Plywood can be painted, stained or treated with a plastic finish as shown here, or it can be waxed, enameled or lacquered. It can also be papered.

TEST DATA ON DOUGLAS FIR PLYWOOD

Because these tests results would be incomplete without some basis of comparison, five materials typical of those sometimes used instead of Douglas Fir Plywood were subjected to exactly the same tests—under exactly similar conditions. In fairness, letters instead of trade names have been used to designate these five materials. A and B are fiber insulating boards; C is a plaster board; D is a hard-compressed fiber board; and E is one of the old-style fiber wallboards.

A number of samples of each of these materials—and of Douglas Fir Plywood—were subjected to each of the following tests, to establish an average strength value that would be eminently fair.

The average moisture content of the Douglas Fir Plywood samples tested was 10%.

All these tests were made by the Northwest Testing Laboratory, which in the Northwest represents the nationally known Pittsburgh Testing Laboratory. A complete log of any test sent upon request.

TENSILE TESTS ON DOUGLAS FIR PLYWOOD

Dimension of Test Specimen			Area, sq. in.	Ultimate load, lbs.	Load, lbs., sq. in.
Thickness	Width, in.	Length, in.			
Load Acting with the Grain of Outside Plies					
3/4", 5-ply	3	18	2.250	8912	4074
5/8", 5-ply	3	18	1.875	8132	4350
1/2", 5-ply	3	18	1.500	8024	5135
3/8", 3-ply	3	18	1.125	5644	4750
1/4", 3-ply	3	18	0.750	5250	6484
3/16", 3-ply	3	18	0.562	4176	7901
Load Acting Across the Grain of Outside Plies					
3/4", 5-ply	3	18	2.250	8796	3932
5/8", 5-ply	3	18	1.875	8326	4491
1/2", 5-ply	3	18	1.500	7664	5108
3/8", 3-ply	3	18	1.125	4684	4141
1/4", 3-ply	3	18	0.750	2552	3291
3/16", 3-ply	3	18	0.562	1622	3016
TENSILE TESTS ON OTHER MATERIALS					
A .500	3	18	1.50	370	248
B .4375	3	18	1.20	152	126
C .250	3	18	0.75	264	352
D .195	3	18	0.585	1276	2180
E .190	3	18	0.570	1248	2189

Key: Materials A and B are fiber insulating boards. C is a plaster board. D is a hard-compressed fiber board. E is an old-style fiber wallboard.

Tensile Tests

Specimens in these tests were cut 3 in. wide and 18 in. long, and the distance allowed between the jaws of the testing machine was 8 in.

As in the compression tests, two series of tests were made on the Douglas Fir Plywood, in one the load acting parallel with the grain of the outside plies, and in the other, across the grain of the outside plies.

Transverse Tests

Here again two series of tests were made on the Douglas Fir Plywood, one in which the load acted parallel with the direction of the grain of the outside plies and another in which the load acted across the grain of the outside plies.

All test pieces were 6 in. wide and 18 in. long. They were placed on supports 12 in. on centers, and the load was applied at midspan.

TRANSVERSE TESTS ON DOUGLAS FIR PLYWOOD

Dimension of Test Specimen			Ultimate load, lbs.	Deflection ultimate load, in.
Thickness	Width, in.	Length, in.		
Load Acting Across the Grain of Outside Plies				
3/4", 5-ply	6	18	1336	.43
5/8", 5-ply	6	18	696	.42
1/2", 5-ply	6	18	702	.53
3/8", 3-ply	6	18	434	.51
1/4", 3-ply	6	18	220	.76
3/16", 3-ply	6	18	214	1.10
Load Acting with the Grain of Outside Plies				
3/4", 5-ply	6	18	1112	.57
5/8", 5-ply	6	18	758	.53
1/2", 5-ply	6	18	388	.92
3/8", 3-ply	6	18	147	1.36
1/4", 3-ply	6	18	50	1.84
TRANSVERSE TESTS ON OTHER MATERIALS				
A 1/2"	6	18	27	.66
B 7/16"	6	18	15	....
C 1/4"	6	18	42	.61
D 3/16"	6	18	51	.92
E 3/16"	6	18	31	.95

Key: Materials A and B are fiber insulating boards. C is a plaster board. D is a hard-compressed fiber board. E is an old-style fiber wallboard.

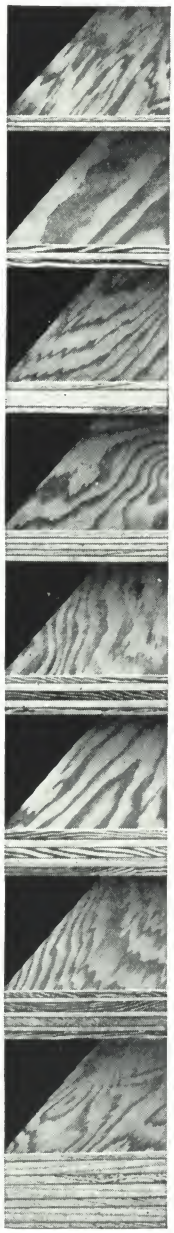
WATER ABSORPTION TESTS

(Figures show per cent absorption at different periods)

Douglas Fir Plywood	4 hours	8 hours	24 hours	48 hours
Thickness				
3/4"	10.3	12.9	18.2	27.3
5/8"	9.7	13.6	19.7	29.6
1/2"	9.0	12.6	18.4	27.5
3/8"	9.2	13.6	17.9	27.5
1/4"	16.9	24.9	29.7	47.4
Material A	23.5	43.3	49.9	67.8
Material B	22.5	32.8	44.8	51.5
Material C	52.3	62.9	66.6	71.2
Material D	7.1	11.5	16.0	23.3
Material E	83.0	98.0	115.9	128.5

Key: Materials A and B are fiber insulating boards. C is a plaster board. D is a hard-compressed fiber board. E is an old-style fiber wallboard.

Representative Plies and Thicknesses of DOUGLAS FIR PLYWOOD



1/4 in.—3 ply

Used largely for drawer bottoms, case and picture backs, and toys. Most Douglas Fir Plywood wallboard is made in this thickness.

3/8 in.—3 ply

Manufacturers of refrigerators, trunks, kitchen cabinets, store fixtures, auto body parts, and instrument cases use this construction.

1/2 in.—3 ply

This is an economical shelf material for cabinets of all kinds. Also used in auto body parts, incubators, etc.

1/2 in.—5 ply

This construction is superior to that just above, both in tensile and in transverse strength. When 1/2 in. is required in large sheets this construction is recommended.

5/8 in.—5 ply

In floor boards, lock boards, seat frames and other automobile body parts and for concrete forms, etc., this thickness finds especial favor.

3/4 in.—5 ply

Used by auto body manufacturers preferring a heavier floor board. Also recommended for heavy shelf construction, store fixtures, concrete form lumber.

7/8 in.—7 ply

Furnishes extraordinary, well-balanced strength. Much used in ship building for bulkhead panels, stateroom partitions, etc.

1 3/16 in.—7 ply

Widely used for instrument boards, ice machine bases, desk tops, bus seats and a variety of other purposes requiring an exceptionally strong and rigid board.

Water Absorption Tests

Note: These tests were made with the usual Douglas Fir Plywood, in which water-resistant glue is used. The specially-fabricated-and-treated Douglas Fir Plywood for concrete forms is made with a different glue which is the most water-resistant of any glue made. This material is then treated with a water-repellant.

All test pieces were cut 6x6 in. The edges of all pieces were sealed with paraffin, after which they were submerged in water to a depth of 1½ in. Weight readings were taken at four, eight, twenty-four and forty-eight hours. The per cent of water absorption at the different periods is given in the table at left.

Nail-holding Tests

In this test all specimens were cut 10x10 in. The specimens were nailed on two pieces of sawed and planed Douglas Fir 1¾x1¾x13½ in. The nails were spaced 3 in. on centers and driven through the test specimens into the supporting member. Supports were spaced 7½ in. on centers. The nailed-up sections were placed in the testing machine in such a manner as to exert a direct pull on the nails.

The Douglas Fir Plywood specimens were given a most severe test in that cement-coated box nails were used, whereas ordinary nails were used in the other materials. In spite of this severe test, eighty-five of the ninety nails were pulled out of the supporting members.

In the other test specimens, every one of the nails remained in the supporting member, the heads of all nails pulling through the test specimens. Douglas Fir Plywood, because of its laminated construction, will hold nails exceedingly well even though they are driven very close to the edge of the plywood.

Compression Tests

Two series of tests were made on Douglas Fir Plywood. In the first series the load acted parallel with the grain of the outside plies. In the second series the load acted across the grain of the outside plies. Only one series of tests was necessary on the other materials, because their grain or fiber did not run in different directions. All compression test pieces were cut exactly 6x6 in. and bearing was obtained by placing the pieces in the testing machine and applying the load on the opposite edge.

TESTS TO DETERMINE THE NAIL-HOLDING POWER OF DOUGLAS FIR PLYWOOD

(6 Nails Used in Each Specimen, Spaced 3 Ins. on Centers)

Test No.	Size of test specimen, in.	Type of nails	Ultimate load, lbs.	Load per nail, lbs.
1	5-ply 10x10x3/4	8d box (Cement-coated)	1670	278
2			1410	235
3			1650	275
			Average per nail	262
4	5-ply 10x10x5/8	6d box (Cement-coated)	1540	256
5			1400	233
6			1430	238
			Average per nail	242
7	5-ply 10x10x1/2	6d box (Cement-coated)	1460	263
8			1270	211
9			1230	205
			Average per nail	226
10	3-ply 10x10x3/8	6d box (Cement-coated)	1410	235
11			1370	228
12			1170	195
			Average per nail	219
13	3-ply 10x10x1/4	4d box (Cement-coated)	790	131
14			830	138
15			790	131
			Average per nail	133

TESTS TO DETERMINE THE NAIL-HOLDING POWER OF MATERIALS A, B, C, D, AND E

(6 Nails Used in Each Specimen, Spaced 3 Ins. on Centers)

Test No.	Size of test specimen, in.	Type of nails	Ultimate load, lbs.	Load per nail, lbs.
Material A				
1	10x10x1/2	1½ gal. roofing	250	41.6
2			290	46.6
3			290	46.6
			Average per nail	44.9
Material B				
4	10x10x7/16	1½ gal. roofing	370	61.6
5			320	53.3
6			370	61.6
			Average per nail	58.8
Material C				
7	10x10x1/4	4d box	260	43.3
8			210	35.0
9			230	38.3
			Average per nail	38.8
Material D				
10	10x10x3/16	4d box	550	91.6
11			590	98.3
12			610	101.1
			Average per nail	97.0
Material E				
13	10x10x3/16	1½ gal. roofing	320	53.3
14			370	61.6
15			330	55.0
			Average per nail	56.6

Key: Materials A and B are fiber insulating boards. C is a plaster board. D is a hard-compressed fiber board. E is an old-style fiber wallboard.

COMPRESSION TESTS ON DOUGLAS FIR PLYWOOD

Dimension of Test Specimen			Area, sq. in.	Ultimate load, lbs.	Ld., lbs., sq. in.
Thickness	Wth., in.	Lgth., in.			
Load Acting with the Grain of Outside Plies					
3/4", 5-ply	6	6	4.50	18538	4186
5/8", 5-ply	6	6	3.75	10644	2893
1/2", 5-ply	6	6	3.00	10492	3497
3/8", 3-ply	6	6	2.25	6630	2860
1/4", 3-ply	6	6	1.50	4198	2855
3/16", 3-ply	6	6	1.125	2014	1917
Load Acting Across the Grain of Outside Plies					
3/4", 5-ply	6	6	4.50	15262	3436
5/8", 5-ply	6	6	3.75	9096	2472
1/2", 5-ply	6	6	3.00	6462	2162
3/8", 3-ply	6	6	2.25	5206	2180
1/4", 3-ply	6	6	1.50	908	609
3/16", 3-ply	6	6	1.125	380	360

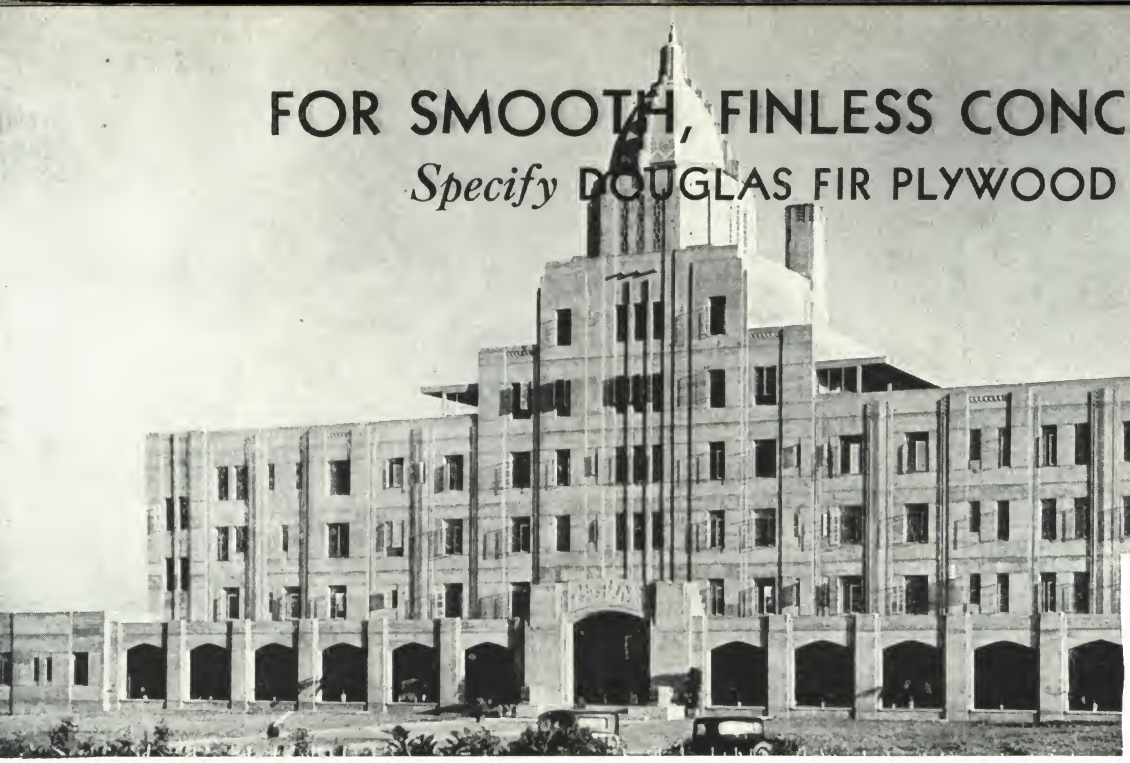
COMPRESSION TESTS ON OTHER MATERIALS

A .500	6	6	3.0	690	230
B .4375	6	6	2.625	448	170
C .25	6	6	1.50	826	550
D .1875	6	6	1.125	846	751
E .1875	6	6	1.125	390	346

Key: Materials A and B are fiber insulating boards. C is a plaster board. D is a hard-compressed fiber board. E is an old-style fiber wallboard.

FOR SMOOTH, FINLESS CONCRETE

Specify DOUGLAS FIR PLYWOOD



● Because smooth concrete walls in large block-type areas with the appearance of stone were specified for the new St. Luke's Hospital in Pasadena, Cal., 5/8-in. 5-ply Douglas Fir Plywood was selected as the most economical and satisfactory form material.

● UNIQUE NEW FORM MATERIAL

Few developments in building construction have so quickly commanded acceptance in every section of the country as the new specially-fabricated-and-treated Douglas Fir Plywood for concrete forms. Already, therefore, the following special advantages of this unique new material—which serves as lumber-and-lining combined—have been demonstrated on scores of buildings, bridges, viaducts and other structures requiring flawless surfaces.

1. Highly water-resistant—can be used 7 to 10 times.
2. Saves 40 to 75% carpentry labor.
3. Speeds up stripping.
4. Gives smooth, finless surfaces immediately.
5. No costly rubbing or plastering necessary.
6. Split-proof, non-bulging, ideal for reverse moulds.
7. Giant sizes reduce lineal footage of joints. *(Stock sizes up to 4 x 8 ft., larger sizes on special order.)*

Although architects and contractors generally prefer the 5/8-in. thickness—which requires no lining—this special Douglas Fir Plywood is also available 1/4-in. thick for lining and for curved forms.

Besides all the other economies offered by this material, *the 5/8-in. panels cost less than shiplap with a suitable lining.*

This new form material is made of thin sheets of selected old-growth Douglas Fir, laminated with alternating grain direction for split-proof, warp-resistant strength. These sheets are bonded with a special glue that is highly water-resistant and far stronger than the wood fibers themselves. Finally each panel is sanded and thoroughly treated with a water-repelling agent developed especially for Fir Plywood.

This double waterproofing protection gives these special panels stamina for 7 to 10 re-uses, after which they are still suitable for sheathing, subflooring, and other utility uses.

● SAVES 40% TO 75% CARPENTRY LABOR

With these giant panels—4 x 8 ft., or even larger on special order—carpenters can erect forms with only a fraction of the handling, sawing and nailing required by ordinary lumber, and the use of the 5/8-in. panels saves all the extra labor of lining forms.

Douglas Fir Plywood also reduces the labor cost of fastening reverse-moulds. These can be nailed or screwed close to the edges of the plywood without fear of splitting.

For curved forms, the 1/4-in. panels can be bent without steaming to a radius as small as 15 in. If steamed for a few minutes, this thickness can be bent to an 8-in. radius.

Douglas Fir Plywood can be cut with either hand or power saws. Also it is remarkably lightweight in proportion to its extraordinary strength. A 4x8-ft. panel of 5/8-in., for example, weighs only about 55 lbs., and a

Below—Left and Right—Douglas Fir Plywood ceiling forms—ready for pouring. Note the flat, seamless surfaces provided by the large panels. These require a minimum of sawing and nailing, which means faster work and a lower labor cost

The finished ceiling after the forms at left had been removed. Note the absence of fins or other blemishes, a result obtained without rubbing, which means a saving of five to fifteen cents a square foot

• Adapted from March, April and July, 1930, issues of Concrete.

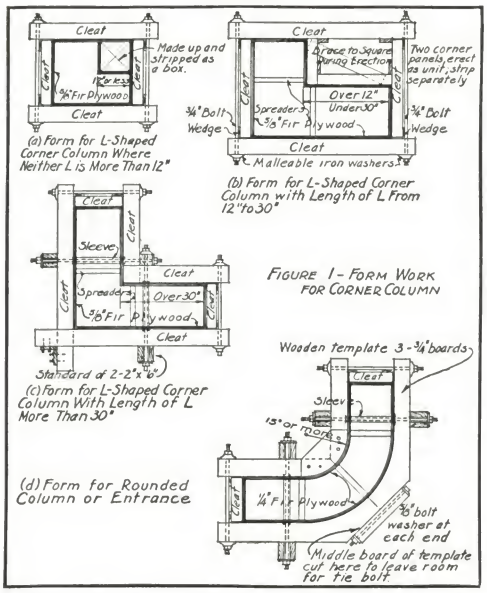


FIGURE 1 - FORM WORK FOR CORNER COLUMN

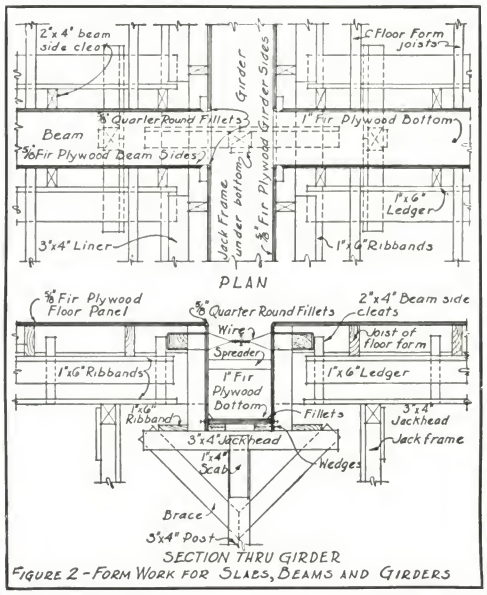


FIGURE 2 - FORM WORK FOR SLABS, BEAMS AND GIRDERS

FIGURE 3 TYPICAL WALL FORM ASSEMBLY

¼-in. panel of the same size weighs only about 24 lbs. Whole sections of forms can be hoisted easily into place.

Specially shaped or shiplapped edges may be obtained on special order at little extra cost. In some types of forms, such edges eliminate fillets and quarter rounds, and simplify dismantling.

• NO COSTLY RUBBING OR PLASTERING

So smooth are the sanded surfaces of this material, and so greatly do the large, tight-fitting panels reduce the footage of joints, that practically no rubbing is necessary. The joints *stay tight* because of Douglas Fir Plywood's stubborn resistance to shrinking and swelling. Thus all the moisture is retained in the concrete, preventing honeycombed surfaces, as well as "fins."

Douglas Fir Plywood's virtual elimination of rubbing means a saving in this one respect alone of from 5¢ to 15¢ a square foot. And if stucco or paint is desired, the smooth surface requires much less of either, and of course much less labor.

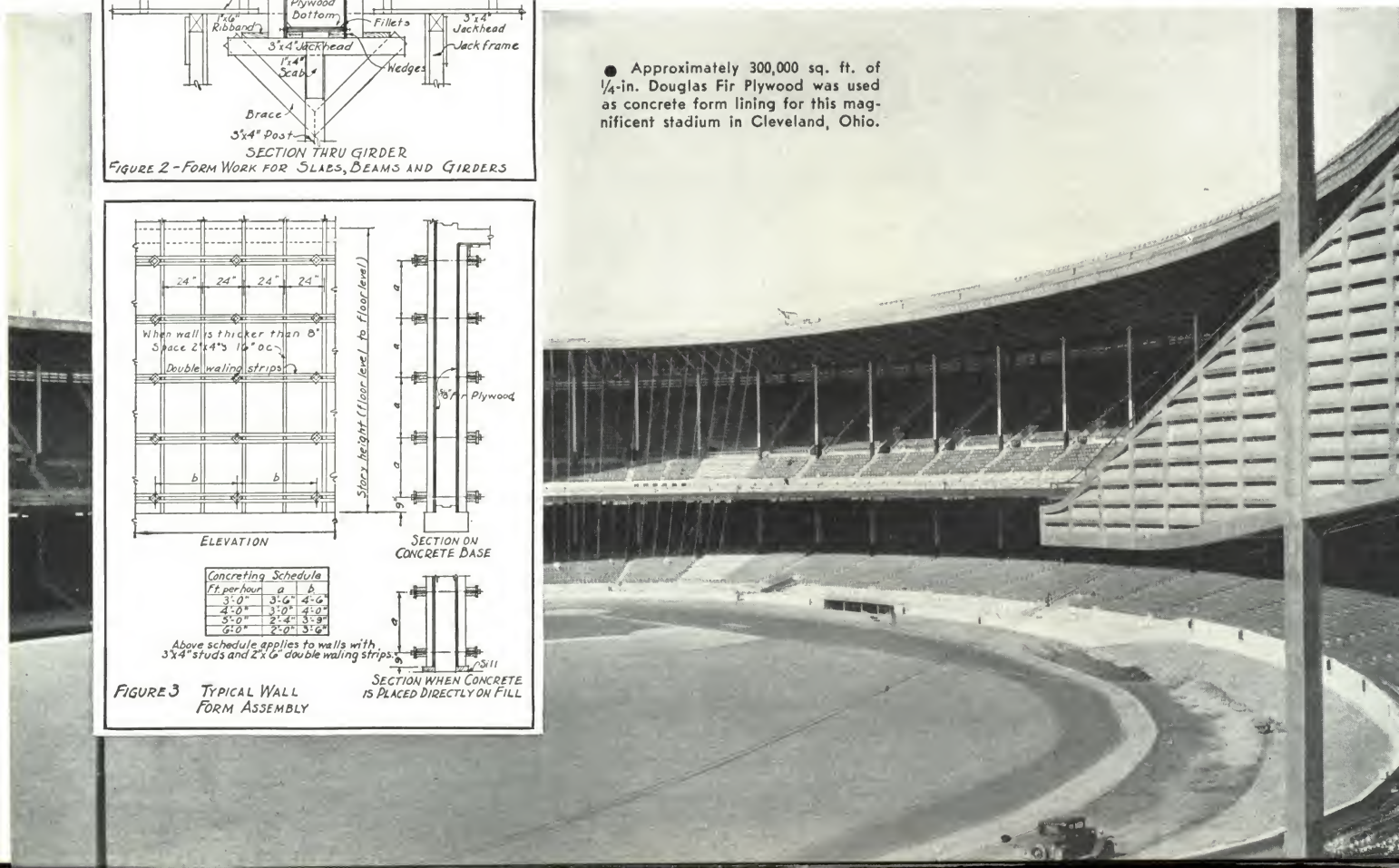
• • •

Figure 1—All cleats, studding, bracing, etc., for Douglas Fir Plywood forms of this type can be exactly the same as if ordinary lumber were being used. Note the simplicity of such forms for rounded corners or entrance columns. A wide variety of corner or intermediate column designs is possible with a minimum of carpentry when Douglas Fir Plywood is used.

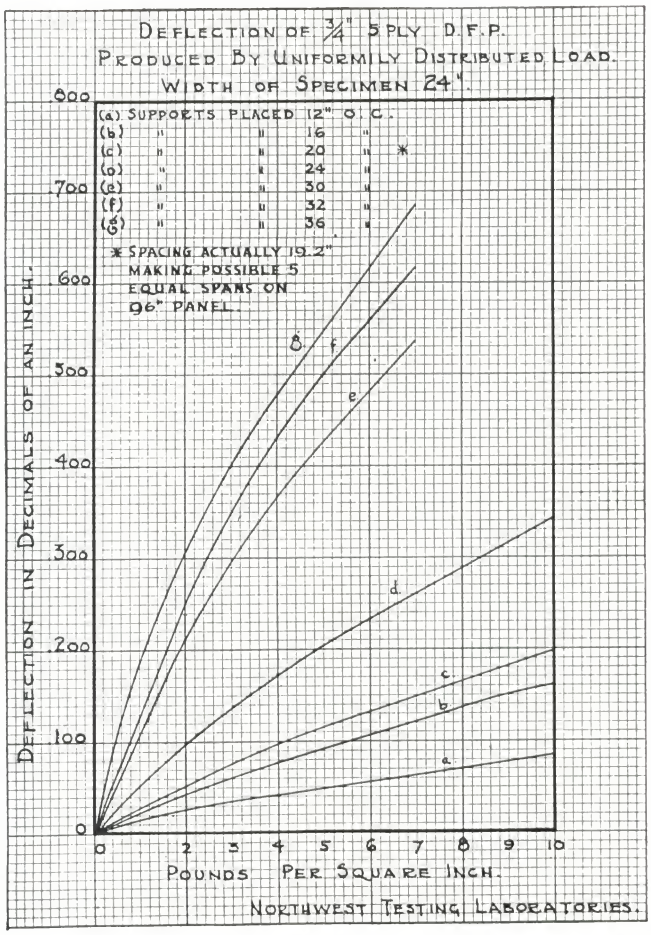
Figure 2—Douglas Fir Plywood forms are of particular value in construction involving a number of identical units, and for such work it is essential that the forms suffer the least possible damage in stripping. The use of double-headed nails wherever possible is therefore recommended. Do not use larger nails than necessary. Forms should not be allowed to drop violently to the floor below, because careless dismantling naturally will reduce the number of re-uses possible.

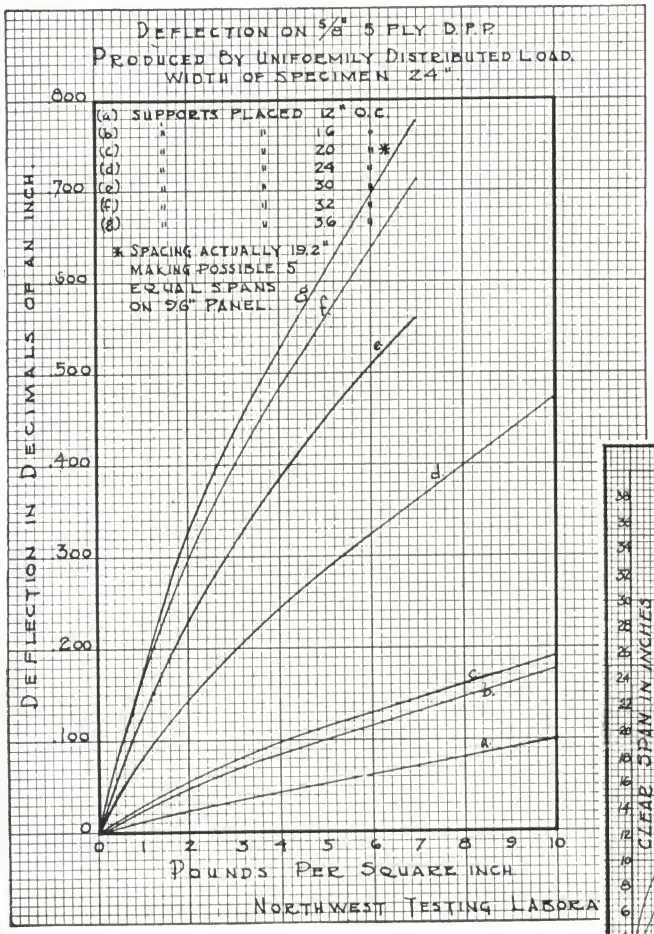
Figure 3—Douglas Fir Plywood forms will be found particularly economical for straight wall work, as the large panels greatly reduce the lineal footage of joints. Straight wall forms of this material can be constructed in large sections, because of its combination of light weight and great strength. The size of such sections will depend upon the equipment available for moving them.

Special Note—For a special Construction Bulletin containing larger reproductions of Figs. 1, 2, and 3, address DOUGLAS FIR PLYWOOD ASSOCIATION, Research and Advertising Headquarters, Dept. 136-Z, Skinner Bldg., Seattle, Wash.



• Approximately 300,000 sq. ft. of ¼-in. Douglas Fir Plywood was used as concrete form lining for this magnificent stadium in Cleveland, Ohio.





The fact that Douglas Fir Plywood requires no overlapping edges means that 1000 sq. ft. of it cover 1000 sq. ft. of surface, whereas 1200 sq. ft. of shiplap would be required for the same area.

● QUICK STRIPPING

The giant Douglas Fir Plywood panels make it possible to strip forms in a fraction of the usual time, and the rugged, laminated construction of this material minimizes dismantling damage.

● EXTRAORDINARY STRENGTH

The remarkable strength of Douglas Fir Plywood—demonstrated by the test data on pages 7 and 8 of this catalogue—means that the panels will never crack or bulge, when properly supported.

However, studs should not be spaced farther apart than on ordinary lumber forms. As in all concrete work, if pouring is faster than 3 ft. an hour, special care with bracing, waling strips and ties is necessary. When the ¼-in. lining is used, the forms need not be built up solidly with lumber. Spacing between the boards can be from 2 to 4 in.

Charts at Left

The graphs at left—showing deflections on ⅝-in. and ¾-in. Douglas Fir Plywood over various spans—will enable the reader to determine precisely what spacing of bracing will be required for a particular form.

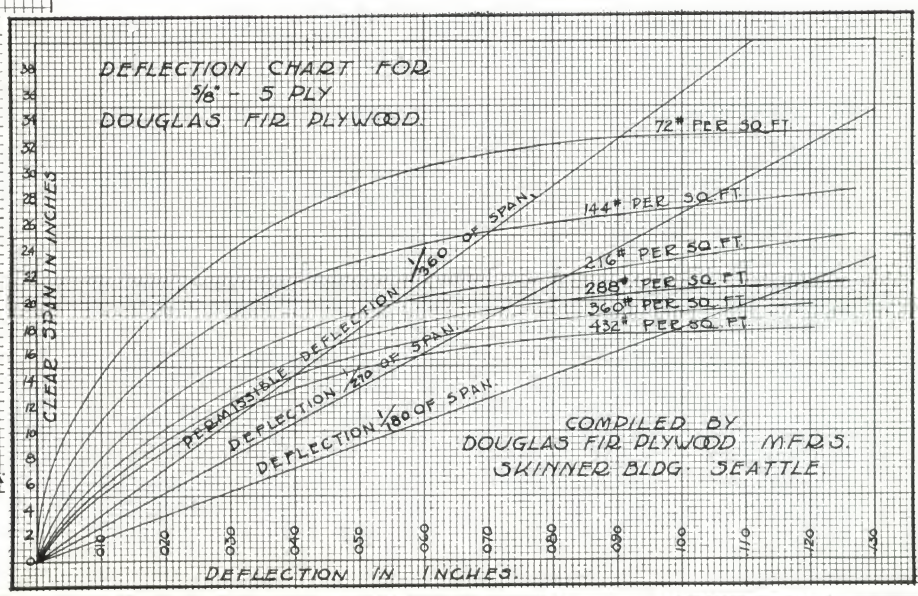
We recommend that studding be spaced no farther apart than 24 inches, and that—except for curved forms or lining—no stock less than ⅝ in. thick be used. Reinforcing members for curved forms must be provided in accordance with the shape of the curve, and the size of the post or wall.

How to Use Chart Below

First determine the permissible deflection in the work at hand. In most steel beam and girder construction the permissible deflection is 1/360th of the span. In a concrete wall or slab a 25% greater "bulge" or deflection, 1/270th of the span, is negligible.

Assume that we have a wall or slab to form that will exert a pressure of 288 lbs. per sq. ft. on the form structure—equal to approximately 2 cu. ft. on concrete—and decide to place the studding 16 in. on centers. If the permissible deflection is 1/270th of the span, we find that the actual permissible deflection is about .06 in. Find the point .060 on the deflection scale and follow this line up until it intersects the 16-in. clear span line.

We find that we are well below the curve load of 288 lbs. per sq. ft. and safely over the permissible deflection line, so that a 16-in. center-to-center spacing of studding is satisfactory.



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DOUGLAS FIR
PLYWOOD

The "Engineered" Lumber!